

Book Reviews

HORMONES, HEALTH, AND BEHAVIOR. Edited by C. Panter-Brick and C.M. Worthman. Cambridge University Press. 1999. 290 pp. ISBN 0 521 57332 7. \$69.95 (hard-cover).

A hormone is a chemical messenger made within cells which then travels to and binds with specific receptors in the same or nearby cells, or cells in a distant organ. Most hormones exert their effects in four broad physiological areas: 1) reproduction, 2) growth and development, 3) maintenance of the internal environment, and 4) regulation of energy availability (Ojeda and Griffin, 1996). Anthropologists have long studied these four areas, with the aim of identifying the causes and consequences of environmental, cultural, and psychological "stress" on these systems. This volume continues this research trajectory, with a focus on combining hormonal measures with the demographic, anthropometric, ethnographic, and behavioral data traditionally collected in the field. Technological advances in endocrinology, immunology, and molecular biology in the last 20 years have enabled the development of efficient, relatively cheap, and highly specific hormonal assays. In the last decade, anthropologists have begun to adapt these tools for field research. The collection of this type of data permits a more refined level of investigation of physiology in anthropology than has previously been possible, and also enables anthropologists to contribute unique data to endocrinology—that is, hormonal data collected in nonclinical (naturalistic) and non-Western settings.

This volume is the outgrowth of a symposium organized by C.M. Worthman and C. Panter-Brick at the 1995 Human Biology Association Annual Meeting, and provides an overview of some of the endocrinological research that anthropologists have been undertaking. As outlined in the introductory

chapter by Worthman and Panter-Brick, the general focus is to unravel the relationships between social ecology and health, using endocrine parameters to understand the processes that intercede in the relationship between behavior and health. The papers cover cortisol and stress (Sapolsky, Flinn); reproductive hormones and cancer (Ellison, Whitten); insulin, catecholamines and obesity (McGarvey); cortisol, epinephrine, and work stress (Panter-Brick and Pollard); reproductive hormones and energetic stress (Panter-Brick and Pollard); and the role of hormones in the epidemiology of growth and development and the consequences for adult health status (Worthman).

The chapter by R.M. Sapolsky is extremely interesting and informative. It reviews many years of his and others' research on the relationships between basal cortisol levels and social rank, primarily in nonhuman primates. Cortisol (hydrocortisone) is the dominant glucocorticoid secreted by the adrenal gland in response to physical or psychosocial stressors. After giving a brief overview of glucocorticoid action, the bulk of Sapolsky's paper summarizes primate research on cortisol concentration and rank, focusing on the roles that individual and group psychosocial contexts play in physiological stress dynamics. This paper nicely illustrates both the complexity of measuring and understanding hormones, as well as the types of unexpected insights that can be gained from long-term, intensive endocrinological field and laboratory research. Sapolsky's main point is to advocate a revisionist paradigm for understanding social rank and stress hormones in primates. Rank in and of itself is not the critical factor determining cortisol levels; rather, there are many factors modulating an individual's perception and experience of both rank and stress, including the type of society and rank system involved, an individual's personal experience of the given rank and society, and above all, an individual's personality. Sapolsky points out that the links among behav-

ior, society, and stress physiology are extremely complicated in nonhuman primates, and that these linkages are orders of magnitude more complicated in humans. Anthropologists should pay heed to this message. Sapolsky's view is clearly well-grounded in stress physiology, and it is obvious from his work that this is critical for research design and interpretation. It would have been useful to see more on field and laboratory methods in this chapter, although the reader can consult Sapolsky's primary papers for this information. In this chapter there is some discussion of but little empirical support for linking cortisol levels and social rank with health status. But this is understandable: establishing a meaningful link between hormones and behavior is the critical first step; this paper shows that this step has been a long-term research agenda in and of itself.

The next chapter, by C.M. Worthman, is a theoretically oriented paper that seems oddly positioned; it might better have been incorporated into the introductory chapter. In this chapter Worthman develops an "integrated model" of human development that links the epidemiology and endocrinology of growth and development with adult health and well-being. She proposes that: 1) hormones mediate or orchestrate environmentally influenced patterns of variation in growth and development (e.g., secular trends or variation across populations in age at reproductive maturity); and 2) variations in developmental trajectories may play an important role in adult health outcomes, i.e., "the epidemiology of development informs the epidemiology of adult illness and well-being" (p. 91), and hormones provide the bridge between the two periods of the lifespan. Worthman adopts a life history approach, with a focus on the neuroendocrine system as the central planner for the organism in allocating resources for growth, reproduction, and maintenance across the lifespan. She reviews four hormonal axes (hypothalamic-pituitary-gonadal, hypothalamic-pituitary-adrenal, hypothalamic-pituitary-thyroid, and somatotrophic) and postulates where, when, and how developmental variation might arise in each. This section goes to

great lengths to describe sex, circadian, and age-related variation in a multitude of various endocrine measures. However, this all-encompassing approach may leave the reader exhausted, yet underwhelmed. In some cases, treatment given to various endocrine issues is superficial and there are the occasional typos or real errors. For instance, in the discussion of the somatotrophic axis, Worthman states (p. 81) that based on a study by Wan Nazaimoon et al. (1996), malnourished Malaysian children have low levels of IGF-I (insulin-like growth factor-I) and IGFBP-1 (insulin-like growth factor binding protein-1). This should read IGFBP-3, since IGFBP-1 was not measured in this study. Interestingly, IGFBP-1 is responsive to nutritional cues and is typically *elevated* in times of energy deficit and serves to inhibit the growth-promoting effects of IGF-I (Lee et al., 1997). In any event, the long-term health outcomes of the hormonal variation Worthman describes are not clearly outlined, and links with specific behaviors are vague. The data and examples come almost entirely from clinical Western data. This is disappointing because the case needs to be made in the first place that there is meaningful hormone variation both within and across populations. This chapter is nevertheless thought-provoking, and should serve as a good starting point for formulating more specific models and testable research hypotheses.

M.V. Flinn's chapter is concise and thorough, and a good example of how tightly focused research on behavior and endocrinology in anthropology is implemented in the field and laboratory. Flinn's research for the last 10 years has centered on longitudinal monitoring of the daily activities, cortisol levels, health, and psychological conditions of rural Caribbean children, with the aim of examining the effects of naturally occurring stressors (e.g., strenuous work, parental discord, conflict with peers or family members) on child health. Flinn's chapter begins by giving an outline of the biology of cortisol, and a brief review of the results of other studies examining stress and cortisol. He then provides a detailed description of his

field and laboratory methods, from which the reader gains a healthy appreciation for the difficulties involved in implementing endocrinological research in the field. He also provides some nice examples of individual-level cortisol profiles coupled with relevant ethnographic data, which illustrate the richness and scope of the data he has collected. Flinn's summary of his research results to date is remarkably similar to Sapolsky's: the stress response of children is a function of a complex mix of each child's perceptions, temperament, biology, socioeconomic and social contexts, and developmental history. One appreciated feature of Flinn's chapter, like Sapolsky's, was acknowledgment of the many difficulties and limitations involved in researching and understanding such enormously complicated aspects of human biology as stress, hormones, and health. Although Flinn's analyses are little more than graphs and tabulations, his data are suggestive of a meaningful link between behavior and cortisol levels. He also discusses his next step: to use immunological measures to assess the health consequences of variation in cortisol levels.

The chapter by C. Panter-Brick and T.M. Pollard on work and hormonal variation deals with physical work (energy expenditure) and sedentary work (psychosocial stress). The section on energy expenditure is a good review of relevant studies dealing with the relationships between energetic variables and reproductive function in both nonindustrial and Western settings. One empirical finding that much is made of in this and other chapters (Worthman, Ellison) is that non-Western women tend to have lower ovarian steroid hormone levels, particularly progesterone, than do Western women. Although it is assumed that this is real, and that it means compromised reproductive function in some way, this has not been demonstrated. It may instead be an artifact of research design and sampling strategy: most studies select normally cycling women to study, but in many non-Western settings women who are having menstrual cycles are those who are not pregnant, not lactating, and not using contraceptives—that is, women who are most likely

to be subfecund. Alternatively, hormonal differences across populations or individuals may be real, but of no physiological consequence. The negative health outcome discussed in this chapter with respect to low energy availability is suppression of reproductive hormone levels. But is this in fact a negative health result or a normal physiological mechanism regulating the daily activities of the reproductive axis? These are critical and basic questions that still need answering. The second part of this chapter, dealing with wage labor in industrial settings and stress, fits well with the overall theme of the book. Two models of job strain are presented that identify high job demand (workload based on one's psychological rather than physical work) and decision latitude or degree of job control as important characteristics that are potentially related to negative health outcomes, namely cardiovascular disease. Epinephrine is a hormone involved in releasing glucose for immediate energy during stress and it can affect blood pressure and cardiac function. In comparing workers between urban industrial and more traditional subsistence settings, those in industrial settings tend to have greater urinary epinephrine levels. Studies conducted within Western societies are reviewed and generally demonstrate that mental workload and time pressures are the key features of sedentary work that lead to elevated epinephrine levels. In general, there do not seem to be clear-cut and consistent associations between work and cortisol levels. Although the authors' point that linking cortisol levels with various job characteristics has proven difficult due to research design and sampling problems is a valid one, we think that Flinn and Sapolsky's findings are also relevant here. Cortisol physiology is complicated and highly sensitive to individual and group characteristics and history. This chapter is crammed with review material (leading to elevated epinephrine levels in the reviewers?), and in the end it was hard to come away with a clear idea of the status of research, or what the fruitful and interesting research directions might be to pursue.

The next chapter, by P.T. Ellison, is concise and very interesting. Whereas Panter-

Brick and Pollard suggested in the previous chapter that low reproductive steroid levels have negative consequences for reproduction, Ellison uses much of the same data in this chapter to argue that low steroid hormone levels may provide health benefits by reducing the risk of certain cancers. He interprets anthropological data as lending support to the idea that ovarian steroid hormones play an important role in the etiology of reproductive cancers, which has been an issue in the medical literature since at least the 1970s. Ellison argues that women in non-Western settings have a lower risk of reproductive cancers by virtue of lower lifetime exposure to ovarian steroids. In Western women, higher exposure is a result of 1) modern reproductive schedules (earlier age at menarche, extended time between menarche and first pregnancy, and relatively short durations of lactation) and 2) higher ovarian and peripheral steroid hormone production. Some of these factors are believed to be directly or indirectly related to diets with excessive positive energy balance that tend to accompany Western lifestyles. The result is lifetime hormone profiles unlike those in non-Western populations, and probably unlike ancestral populations as well. How this pattern relates to cancer is not straightforward, but the emerging evidence that supports this relationship is outlined nicely in this chapter. Briefly, the extended period of time between menarche and first pregnancy in Western women is a time of heightened risk for the initial development of cancer, and high steroid hormone levels exacerbate this by promoting the growth of cancer cells. Ellison concludes that Western women would do well to decrease their positive energy balance by exercising more and reducing caloric intake. While reproductive schedules certainly do differ between Western and more traditional populations, it is not clear yet, as discussed above, whether fecund non-Western women have lower ovarian steroid levels than Western women do. Moreover, if there are differences in hormone levels, the causes need to be investigated and not just assumed to be related to energy balance. Finally, if there are differences in

hormone levels or lifetime exposure, it remains to be demonstrated that these differences influence the risk of reproductive cancers. This is clearly an area of research where anthropologists should have much to contribute in years to come.

Whereas Ellison focuses on reproductive cancer as a result of higher lifetime exposure to estrogens from positive energy balance, P.L. Whitten's chapter argues that specific components of the modern diet may also be etiologically important. She suggests that modern humans have higher exposure to estrogen as a result of our low-phytoestrogen, high-fat, and low-fiber diets. Each of these dietary components can supposedly influence levels of endogenous steroids. High fiber and low fat in the diet increase gut transit time and consequently decrease levels of circulating steroids. Phytoestrogens, which are common in the more fibrous parts of many plants, have complicated and not very well understood effects—they may have estrogenic or antiestrogenic effects depending upon the type of compound, the dosage, and other components present in the diet. The reason why the presence of phytoestrogens in the diet should help reduce cancer risk is unclear here; it seems the strongest evidence is epidemiologic data showing that Asian women tend to have low rates of reproductive cancers coincident with high-fiber, low-fat, high-phytoestrogen diets. There is also evidence suggestive of adverse adult health outcomes from developmental exposure to exogenous estrogens: for example, exposure in utero to diethylstilbestrol, a synthetic estrogen, is associated with a higher risk of early adult onset of vaginal-cervical cancer. Whether early and prolonged phytoestrogen exposure could have similar effects is a question ripe for research. Whitten then considers why the primate reproductive system is sensitive to diet in the first place, and points to the literature proposing that dietary cues are used to synchronize the timing of reproduction with optimal resource availability. This section includes a discussion of a generalized hominoid diet and human food preferences, with a heavy focus on fiber, fat, and

fruit, but neglecting other important dietary components, such as protein. Whitten argues that although humans, like apes, evolved to select high-energy, low-fiber foods (such as ripe fruit), industrialized humans have achieved an "optimal diet" which is very energy-dense with low fiber content. She concludes that although hominoid food choices and preferences evolved to optimize reproduction, they have developed in modern humans to the point of detriment with respect to reproductive cancers. One thing that is not entirely clear in this line of research is whether it is high fiber, low fat, low energy content, or some interaction all these components that cause lower circulating hormone levels. This chapter presents some very interesting ideas linking behavior, hormones, and health; and it is timely reading, given the current and widespread interest in phytoestrogens and reproductive health.

The final chapter by S.T. McGarvey epitomizes many of the strengths and weaknesses of the book. The social environment under examination in this case is economic modernization, which proves every bit as troublesome to operationalize as other psychosocial stressors found throughout this book. McGarvey's aim is to link both physiological and psychological aspects of a modernizing lifestyle with changes in hormones associated with energy metabolism (insulin) and the sympathetic nervous system (catecholamines), which are in turn related to cardiovascular disease risk. In Samoa, where McGarvey has conducted extensive fieldwork, changes in energetic variables that accompany departure from traditional activity and dietary patterns have been identified as the major force in contributing to negative health outcomes, including diabetes and cardiovascular disease. The relationships among diet, activity levels, psychosocial stress, insulin metabolism, and indicators of cardiovascular disease risk (blood pressure, hypertension, adiposity, catecholamines, and lipid and lipoprotein levels) are complex and are laid out in some detail in this chapter. Although a prospective study design incorporating ethnographic and physiologic data collection can help to pinpoint some of the

critical variables that change with modernization, it is not adequate in and of itself for disentangling cause and effect or the exact pathways involved. McGarvey has very rich data, but the analyses in this chapter do not do the data justice. Standard error bars and indicators of significant differences are not included in the graphical presentation of most of the data, making interpretation of results impossible, and analyses that attempt to isolate independent effects of variables as well as interactions among variables are not presented. Although more formal analyses may be available in primary papers, the lack of presentation of or reference to more rigorous data analyses is a shortcoming found throughout much of this book.

What becomes very clear early and throughout this book is the enormous complexity of the subject matter. Even the most basic pathways linking behavior, hormones, and health are not simple or straightforward. The most productive way to study complex phenomena is to start with simple models and testable hypotheses. Many of the contributions in this book could benefit from adopting this approach. Oft-neglected first steps in this line of research are, first, good documentation of variation, and second, demonstration that variation is or is not meaningful with respect to specific health outcomes. Once these are done, we can begin to wrangle with disentangling cause and effect, identifying the multitude of physiologic and sociocultural variables involved, and deciding whether there are links to developmental events. This volume charts an initial course for attaining these goals, and is a nice illustration of the types of contributions that anthropologists can make to this field. This volume is timely and relevant because the research agenda and topics it outlines encompass areas of health research that have recently been targeted as priorities for various funding agencies, including the health effects of urbanization and modernization, the relationship of chronic diseases to developmental events, energetics and reproductive function, repro-

ductive health, and the relationships among behavior, stress, and hormones. This book serves as a good overview of these research areas, but it is not appropriate for undergraduate students and would be hard going for most graduate students, unless they have some background in endocrinology. It will be of interest to researchers in reproductive health, endocrinology, human biology, anthropology, sociology, and epidemiology.

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